Propotional Revision of WCDMA and LTE

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Abstract *— Mobile communication is one of the warmest areas and it is emerging tremendously fast in present times, thanks to the advances of technology in all the fields of mobile and wireless communications. Nowadays the use of 3G mobile communication systems appear to be the standard, while 4G stands for the next generation of wireless and mobile communications. This comparative study between 3G & 4G tells about the background and the vision for the 4G. We first present a evaluation on the development history, characteristics, status of mobile communication and related 3G - 4G perspectives. An overall 4G framework features, having the basic keys (diversity and adaptability) of the three targets (terminals, networks, and applications). We present it in both external and internal diversity of each target to illustrate the causes and solutions of the adaptability feature. Then, the 4G domain of each feature in the framework is discussed from technical point, showing techniques and possible research issues for sufficient support of adaptability. At the end, a summary on 4G visions and some of the issues this new technology may face. All radio access technologies have to solve the same problems: to divide the finite RF spectrum among multiple users as efficiently as possible. GSM uses TDMA and FDMA for user and cell separation. UMTS, IS-95 and CDMA-2000 use CDMA. WiMAX and LTE use OFDM.*

Keywords — *OFDM, HSPA, LTE, MIMO, MC-CDMA, WCDMA, UMB.*

I. INTRODUCTION

- Mobile broadband is fetching a legitimacy, as the Internet generation grows accustomed to having broadband access wherever they go, and not just at home or in the office. Out of the projected 1.8 billion people who will have broadband by 2012, some two-thirds will be mobile broadband consumers — and the majority of these will be served by HSPA (High Speed Packet Access) and LTE (Long Term Evolution) networks. People can already browse the Internet or send e-mails using HSPA-enabled notebooks, replace their fixed DSL modems with HSPA modems or USB dongles, and send and receive video or music using 3G phones. With LTE, the user's experience will be even better. It will further enhance more demanding applications like interactive TV, mobile video blogging and advanced games or professional services. LTE offers several important benefits for consumers and operators: Performance and capacity - One of the requirements on LTE is to provide downlink peak rates of at least 100Mbit/s. The technology allows for speeds over 200Mbit/s and Ericsson has already demonstrated LTE peak rates of about 150Mbit/s. Furthermore, RAN (Radio Access Network) round-trip times shall be less than 10ms. In effect, this means that LTE — more than any other technology — already meets key 4G requirements. 3GPP (GSC 11) Work plan worked on evolving HSPA to HSPA+ with improvements (HSDPA and HSUPA) and connectivity to the SAE defined under LTE work. This preserved improvements for latency (protocol evolution and functional split), but had constraints in terms of support for legacy terminals and hardware changes.

II. *Differentiate between 3G & 4G* -3G is currently the world's best connection method when it comes to mobile phones, and especially for mobile Internet. 3G stands for 3rd generation as it just that in terms of the evolutionary path of the mobile phone industry. 4G means 4th generation. This is a set of standard that is being developed as a future successor of 3G in the very near future. The biggest difference between the two is in the existence of compliant technologies. There are a bunch of technologies that fall under 3G, including WCDMA, EV-DO, and HSPA among others. Although a lot of mobile phone companies are quick to dub their technologies as 4G, such as LTE, WiMax, and UMB, none of these are actually amenable to the specifications set forth by the 4G standard. These technologies are often referred to as Pre-4G or 3.9G. 4G speeds are meant to exceed that of 3G. The UE terminal complexity for WCDMA or CDMA systems is quite high, making terminals exclusive, resulting in poor performing implementations of receivers and inhibiting the implementation of other performance enhancements.

III. *Features of 3G* - 3G telecommunications, is a generation of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunications- 2000 (IMT-2000) specified by the International Telecommunication Union.] Application services include wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment. To meet the IMT-2000 standards, a system is required to provide peak data rates of at least 200 kbit/s. Recent 3G releases, often

denoted 3.5G and 3.75G, also provide mobile broadband access of several Mbit/s to smart phones and mobile modems in laptop computers. The following standards are typically branded 3G: • the UMTS system, first offered in 2001, standardized by 3GPP, used primarily in Europe, Japan, China (however with a different radio interface) and other regions predominated by GSM 2G system infrastructure. The cell phones are typically UMTS and GSM hybrids. Several radio interfaces are offered, sharing the same infrastructure: o The original and most widespread radio interface is called W-CDMA. o The TD-SCDMAradio interface, was commercialised in 2009 and is only offered in China. o The latest UMTS release, HSPA+, can provide peak data rates up to 56 Mbit/s in the downlink in theory (28 Mbit/s in existing services) and 22 Mbit/s in the uplink. and 22 Mbit/s in the uplink.

Channel bandwidth	*5 MHz*
Duplex mode	*FDD and TDD*
Downlink RF channel structure	*Direct spread*
Chip rate	*3.84 Mbps*
Frame length	*10 ms*
Spreading modulation	Balanced QPSK(downlink) Dual-channelQPSK(uplink) *Complex spreading circuit*
Data modulation	QPSK (downlink) *BPSK (uplink)*
Channel coding	*Convolutional and turbo codes*
Channel multiplexing in downlink	*Data and control channels time multiplexed*
Channel multiplexing in uplink	Control and pilot channel time multiplexed *I&Q multiplexing for data and control channel*
Handover	Soft handover Interfrequency handover

Table 1 Parameters of WCDMA

IV. *Features of 4G* - 4G, a range of new services and models will be existing. These services and models need to be further examined for their interface with the design of 4G systems. Figures 2 and 3 demonstrate the key elements and the seamless connectivity of the networks.

[1]. Considerably increased peak data rates, scaled linearly according to spectrum allocation

[2]. Instantaneous downlink peak data rate of 100Mbit/s in a 20MHz downlink spectrum (i.e. 5 bit/s/Hz)

[3]. Instantaneous uplink peak data rate of 50Mbit/s in a 20MHz uplink spectrum (i.e. 2.5 bit/s/Hz)

[4]. Expectations of additional 3G spectrum allocations

[5]. Greater flexibility in frequency allocations – No native support for circuit switching domain (e.g. voice)

[6]. Continued cost reduction

[7]. Keeping up with other (including unlicensed) technologies (eg. WiMAX)

[8]. Use the growing experience with the take-up of 3G to clarify the likely requirements of users, operators and service providers in the longer term

Figure 1(4G VISIONS)

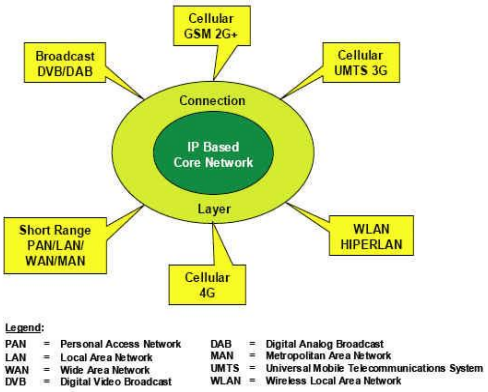

Figure 2

A. *Terminals* - Till date the "terminal" for accessing mobile services has been the mobile phone. With the advanced 3G and also the 4G in future, we can also

expect to see a broadening of this concept. User interfaces of terminals will vary from traditional keyboard, display, and tablet, to new interfaces based on speech, vision, touch, soft buttons, etc. These will be general-purpose computing and communication devices, and devices with more specific purposes to serve particular marker segments. There will still be recognizable mobile phones. But many of these will have larger screens to display Internet pages or the face of the person being spoken to. There will be smaller "smart-phones" with limited web browsing and e-mail capabilities. The addition of mobile communication capabilities to laptop and palmtop computers will speed up the Convergence of communication and computing, and bring to portable computing all the functions and features available on the most powerful desktop computers. There will be videophones, wrist communicators, palmtop computers, and radio modem cards for portable computers. Innovative new voice based interfaces will allow people to control their mobile communication services with voice commands.

B. *Networks* - Worldwide roll-out of 3G networks are delayed in some countries by the enormous Costs of additional spectrum licensing fees. In many parts of the world 3G networks do not use the same radio frequencies as 2G, requiring mobile operators to build entirely new networks and license entirely new frequencies. So that a number of spectrum allocation decisions, spectrum standardization decisions, spectrum availability decisions, technology innovations, component development, signal Processing and switching enhancements and inter-vendor cooperation have to take place before the vision of 4G will materialize.

C. ***Applications* -** The emerging applications for 3G and 4G wireless systems typically require highly Heterogeneous and time varying quality of service from the underlying protocol layers. So adaptability will be one of the basic requirements to the development and delivery of new mobile services. Promising techniques and possible topics may include: Mobile application should refer to a user's profile so that it can be delivered in a way most preferred by the subscriber, such as context-based personalized services. This also brings the applications with adaptability to terminals that are moving in varying locations and speeds. Techniques such as adaptive multimedia and unified messaging take the terminal characteristics into account and ensure that the service can be received and run on a terminal with the most suitable form to the host type

The 4G technology will be able to support Interactive services like Video Conferencing (with more than 2 sites simultaneously), Wireless Internet, etc. The bandwidth would be much wider (100 MHz) and data would be transferred at much higher rates. The cost of the data transfer would be comparatively very less and global mobility would be possible. The networks will be all IP networks based on IPv6. The antennas will be much smarter and improved access technologies like OFDM and MC-CDMA (Multi Carrier CDMA) will be used. Also the security features will be much better.

Long-Term (Radio) Evolution or LTE is also part of 3G technology. It's a 3GPP its research item for Release 8. It's also known as 3.9G or "Super 3G" by some researchers. It's planned to commercialize in 2009. It was aims at peak data rates of 200 Mbps (DL) and 100 Mbps (UL).

The WiMax lobby and the people who are working with the WiMax technology are trying to push WiMax as the 4G wireless technology. At present there is no consensus among people to refer to this as the 4G wireless technology. I do not think this is popular with the researching community. WiMax can deliver up to 70 Mbps over a 50Km radius. As mentioned above, with 4G wireless technology people would like to achieve up to 1Gbps (indoors). WiMax does not satisfy the criteria completely. Also WiMax technology (802.16d) does not support mobility very well. To overcome the mobility problem, 802.16e or Mobile WiMax is being standardized. The important thing to remember here is that all the researches for 4G technology is based around OFDM. WiMax is also based on OFDM. This gives more credibility to the WiMax lobby who would like to term WiMax as a 4G technology.

V. *Applications of 4G* - Virtual Presence: This means that 4G provides user services at all times, even if the user is off-site. Virtual navigation: 4G provides users with virtual navigation through which a user can access a database of the streets, buildings etc of large cities. This requires high speed data transmission.

A. *Tele-Medicine*: 4G will support remote health monitoring of patients. A user need not go to the hospital instead a user can get videoconference assistance for a doctor at anytime and anywhere.

B. *Tele-geoprocessing applications*: This is a combination of GIS (Geographical Information System) and GPS (Global Positioning System) in which a user can get the location by querying.

C. *Crisis management*: Natural disasters can cause breakdown in communication

VI. *Wi-Fi vs. WiMAX* - Matching WiMax to Wi-Fi is akin to comparing apples to oranges. Initially it's easy to see why the comparison would exist, as most people think WiMax is simply a more vigorous version of Wi-Fi. Indeed they are both wireless broadband technologies, but they differ in the technical execution and finally their business case is very different. In addition to the technical differences that exist, the marketplace difference is

that equipment is more or less non-existent for WiMax and certainly not geared towards a residential environment with very high pricing to be expected. It will take at least 2 years to see equipment of mass market uptake pricing.

WiMax could not be commercially available until the second half of 2005, and even then at a very controlled level. This is primarily due to standardization issues. In fact, it could not be until 2006 that a robust production and implementation would happen due to the ramp-up period for manufacturers. This is certainly one challenge to the widespread adoption of WiMax. Additionally, WiMax will have issues of pricing, and will remain far more expensive than Wi-Fi. WiMax will be primarily adopted by businesses to replace or displace DSL, and offices that want to cover a lot of territory without entering the world of endless repeaters that are necessary with the 802.11 technologies. It will take some time (2 years) for WiMax to significantly reduce its price-point for residential uptake. WiMax will not displace Wi-Fi in the home because Wi-Fi is advancing in terms of speed and technology. Each year brings a new variant to the 802.11 area with various improvements.

Additionally, for commercial deployment, frequency allocation will be an issue. With the three main communications players controlling the best frequencies, it will be hard to get the type of traction needed with the remaining companies operating in the frequencies available. WiMax will become extremely robust and displace Wi-Fi as the deployment of choice for commercial deployments, but that could not even begin until the end of 2006. Based upon the number of public hotspots already deployed, WiMax will not be chosen to replace those as they are up and running adequately and personnel involved understand how to work with the technology. The business case does not exist at the hotspot level. Where it may exist is for wider free use deployments such as city deployments (free ones) and other government sponsored or carrier sponsored (with ultra-inexpensive pricing for consumers) deployments. If this happens then it's only Wi-Fi that will be displaced, but also cable and DSL will also lose a percentage of their subscriber base. What will cause the displacement is the consumer's proven desire for a bundled package.

VII. *CONCLUSION* - 4G seems to be a very promising generation of wireless communication that will change the people's life to wireless world. There are many striking attractive features proposed for 4G which ensures a very high data rate, global roaming etc. New ideas are being introduced by researchers throughout the world, but new ideas introduce new challenges. There are several issues yet to be solved like incorporating the mobile world to the IP based core network, efficient billing system, smooth hand off mechanisms etc. 4G is expected to be launched by 2010 and the world is looking forward for the most intelligent technology that would connect the entire globe. Someday 4G networks may replace all existing 2.5G and 3G networks, perhaps even before a full deployment of 3G. multiple 3G standards and springing up that would make it difficult for 3G devices to be truly global. A rapid increase of mobile data usage and emergence of new applications such as MMOG (Multimedia Online Gaming), mobile TV, Web 2.0, streaming contents have motivated the 3rd Generation Partnership Project (3GPP) to work on the Long-Term Evolution (LTE) on the way towards fourth-generation mobile.The main goal of LTE is to provide a high data rate, low latency and packet optimized radio access technology backup flexible bandwidth deployments. Same time its network architecture has been designed with the goal to support packet-switched traffic with all-in-one mobility and great quality of service.

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